# Wildlife Strike Prevention: a mainstream safety problem

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Birds have always inspired aircraft designers, but they are also one of the threats jeopardizing the safety of aircraft, their crews and passengers. Is it not ironic? Since the Wright brothers, aircraft have been colliding with birds and other animals, in so-called wildlife strikes. At this very moment, while you are reading this, wildlife strikes are occurring at many places around the world, both at airports and in the wider airport vicinity and military aircraft are striking birds en-route when performing low level navigation.

The majority of wildlife strikes have no effect on the flight of the aircraft. However, the struck animals are less fortunate. Occasionally wildlife strikes can put the safety of passengers, crews and population on the ground at stake. Costs are high when operations are affected and when aircraft are damaged.

As a worldwide problem, professionals around the globe have been working on this issue for several decades and have been uniting efforts in sharing experiences, methods, measures and policies to decrease this risk. To get the best result, all stakeholders must work together – it is not an issue to be addressed only by aerodrome operators.

## *World Birdstrike Association – The New IBSC*

Since 1966, the International Bird Strike Committee (IBSC) has held biennial meetings, sharing information and best practices. In 2008, Brasília hosted an excellent combined IBSC and Caribbean meeting (CAR)/South American (SAM) Bird and Wildlife Hazard Prevention Committee (CARSAMPAF).

In January 2012, the IBSC Steering Committee decided to "*rebrand, reinvigorate and reposition the IBSC to more than just a sharing information institution*". The objective is to build a membership association, steered by a committee, including a name change in order to bring aviation stakeholders such as the International Federation of Airline Pilots Association (IFALPA), International Air Transport Association (IATA), International Council of Aircraft Owner and Pilot Associations (IAOPA), etc. to work with the IBSC community.

At the Stavanger (Norway) IBSC meeting in June 2012, the World Birdstrike Association (WBA) presented its eight goals:

1. Establish a solid and transparent financial structure;
2. Improve and modernize the website;
3. Establish a "0" starting point and an agreed norm for the wildlife strike risk;
4. Raise all stakeholders' awareness in order to work together to reduce the wildlife problem;
5. Set up and maintain a database, peer reviews, recommendations, papers, etc;
6. Become the quality assurance certification agency;
7. Develop, in close cooperation with the stakeholders, an action plan; and
8. Gain International Civil Aviation Organization (ICAO) support and recognition.

The WBA website (www.worldbirstrike.com) was created in December 2012. Five months later, thirty-eight people representing twenty-five different organizations attended the kick-off meeting for the Joint Global Action Plan on the reduction of bird/wildlife strikes. The Brazilian Civil Aviation Agency (ANAC) was present, as were ICAO (via teleconference), civil and military aviation authorities, bird strike committees, aircraft manufacturers, IFALPA and IATA. The key outcome of the meeting was the development and acceptance of the following agreed Statement of Intentions:

- In principle, we are supportive of the intention to develop, together with the other signees of this statement, a Joint Global Action Plan on the Reduction of the Bird/Wildlife Strike Risk to Aviation.
- This industry and environmental initiative aims to increase flight safety whilst respecting nature and wildlife.
- This Action Plan concentrates on integrating existing best practices whilst encouraging innovation and aims at measurable results.
- It will contain clear, well-addressed to-the-point recommendations and practical guidance material.
- It serves also as a source of "continuous education and enhancement", inspiring stakeholders and authorities in all aviation regions.

## *Aircraft Characteristics and Wildlife Strikes*

In the past, aircraft flew at lower speeds and had propeller-powered engines that projected the engine noise forward. Wildlife heard the aircraft approaching at an earlier point in time, giving it time to respond and get out of the way. Modern aircraft are faster, and the turbofan-powered jet engines primarily project produced noise backwards, away from the wildlife in the flight path. As a result, wildlife hears the approaching aircraft later and has less time to respond. In addition, aircraft size has increased over time, resulting in a larger area with which wildlife can collide.

There are a few factors influencing the extent of damaging wildlife strikes:

- *Phase of flight* – damage is more likely to occur during take-off when the aircraft is accelerating and the engine setting is higher;
- *Part of the airplane* – the resistance varies among the different parts; and
- *Number and size of wildlife* – certification requirements may be not sufficient or more than one component may be damaged.

The high speed of modern aircraft gives wildlife and crew very little time to avoid the collision. The impact energy is estimated by *kinetic energy of impact = ½ x bird mass x squared velocity*. When aircraft strike a single bird of 4 kilograms at 145 knots, the kinetic energy equals to a car hitting a 25-kilogram block of concrete speeding at 100 km/h (to compare; a small pebble can crack a car's windshield).

Wildlife species that are heavy and congregate in flocks are the most hazardous. Jet engines are designed to resist wildlife ingestion weighing 1.85 kg for small inlets and up to 3.65 kg for large inlets. However, many wildlife species at and around airports exceed these masses, either individually or collectively in flocks, and therefore engine limits may be overcome as exemplified by the *Hudson Miracle* on January 15th, 2009.

### *Wildlife at Airports*

General public perception often believes that wildlife are randomly present at any place. However, when studying wildlife, it becomes apparent that the opposite is true. Driven by a need for food, water and shelter, wildlife visit specific locations, at specific times, and for specific reasons.

Airports attract all types of wildlife that are a hazard to aircraft. The most important attractants inside aerodromes are plants and animals that are linked with each other in an aerodrome-food-chain. Plants, grasses and seeds are eaten by insects, worms and other invertebrates, which are in turn eaten by rodents, reptiles and amphibians. At all these levels, birds and other wildlife are attracted. In turn, wildlife killed by aircraft attracts scavengers like vultures. Apart from carcasses, scavengers are also attracted by organic waste in garbage bins, landfills and other garbage disposal sites, which are sometimes located adjacent to airports, stimulating the movement of birds to infringe aircraft flight paths.

### *Guidance on Wildlife Strike Prevention*

Aviation safeguarding is the main objective of ICAO. In order to achieve this goal, ICAO issues Standards and Recommended Practices (SARPs). Standards shall be implemented by the 191 ICAO member states, including Brazil, and Recommended Practices are their recommended way to reach the targets. Just like many other issues addressed by SARPs, wildlife strike prevention is a complex issue that requires specialist knowledge. In 2003, ICAO upgraded the Recommended Practices on wildlife strike prevention into Standards, detailed in ICAO Annex 14, Volume I, Chapter 9.4. This means that these Standards are no longer optional and their implementation is mandatory.

The ICAO Airport Services Manual, Part 3, is the manual on 'Wildlife Control and Reduction' (Doc 9137) and provides further guidance material to manage wildlife strikes. The fourth edition of Doc 9137 was updated in 2012, with the previous edition dating back 20 years. Many improvements to Doc 9137 include the clarification of vegetation management, data collection and training for aircraft operators, air traffic control and airport operators, amongst others, making this Doc one of the most important guidelines for wildlife strike prevention around the world. Other important focuses in the fourth edition are the detailed training requirements on "*competent personnel*" and the provision of details on what is "*an appropriate authority*".

The ICAO standards focus on three processes:

1. Collecting information on the presence of living wildlife and wildlife strikes;
2. Ongoing risk assessments of the wildlife strike hazard; and
3. Measures to minimize the likelihood of wildlife strikes.

### *Collecting information on wildlife – the 5 W-questions*

Long term wildlife monitoring clarifies that many factors contribute to their presence or absence. Collecting that information to answer five key questions will provide insight about the number, location and behaviour of wildlife at airports, and provide solid data for risk assessments. We refer to the five questions as the '5 W-questions' (Table 1).

The *Why*-question is the most important because it provides information about the nature of the wildlife attractant. This way of thinking is also necessary for processing biological remains from a strike, showing why it is important to identify the species through DNA or feather analysis. With this information, ways to eliminate or mitigate these attractants on or off-aerodrome may be developed to discourage specific species from visiting or transiting through the aerodrome.

As the Table 2 shows, the spread sheet can be customized to register the results of mitigating actions and any other comment. Such data may assist in demonstrating due diligence by an airport operator involved in a legal dispute related to wildlife strikes.

Doc 9137 states that wildlife events shall be recorded on a wildlife form or by national reporting guidelines. Despite the ICAO standards, it appears that the vast majority of wildlife strikes go unreported, often due to lack of a functional reporting system, or because reports are not submitted annually to ICAO. Brazil commenced the latter in 2009.

Information about the struck wildlife, such as the species and number of individuals, is often missing in submitted reports. Although, this is unavoidable in some instances, particularly where a carcass is not located.

**Table 1:** The 5W-Questions for wildlife management at airports

| W-Question | Information needed | Example #1 | Example #2 |
|---|---|---|---|
| When? | Date & Time | Lapwings (at dawn & dusk) | Lapwings (all day) |
| Where? | Location | Rock Doves (on the runway) | Rock Doves (inside the hangar) |
| Which species? | Body mass | Horned Screamer | Barn Swallow |
| What number? | Group size | Cattle Egrets (51-100 individuals) | Cattle Egret (1 individual) |
| Why? | Activity | Vulture (feeding on a runway carcass) | Vulture (hovering over the runway) |

**Table 2:** Example of wildlife data collected at airports

| When | | Where | Which | What | Why | Harassment | Results/Comments |
|---|---|---|---|---|---|---|---|
| Date | Time | Location | Species | Number | Activity | Action taken | |
| 14/02/2014 | 07:00 | THR14 | Cattle Egret | 12 | Eating | Shell crackers | Left airside |
| 14/02/2014 | 07:16 | RWY05 | Rock Dove | 50 | Foraging | Cattle whip | Left airside |
| 14/02/2014 | 08:05 | RWY02 | Black Vulture | 4 | Flying | No action | Left airside |
| 14/02/2014 | 08:06 | PLOT09 | Southern Lapwing | 5 | Struck | Removed | Vultures hovering |

However, even when a carcass is observed, the species and number are still not recorded. Without this crucial information about wildlife strikes, developing and evaluating effective wildlife hazard management plans (WHMP) is very difficult.

### *Risk Assessment*

Risk assessment considers the input data as two variables:

- *Probability* – likelihood of a strike to occur; and
- *Severity* – related to the scale of the damage in relation to the size and number of species struck.

The probability of collision may vary even within species. Females and males can behave differently in the same location and can undertake different activities which influence their time airside. Furthermore, juveniles with less airside experience are more likely to be struck compared to more airport-savvy adults. The experience concept also applies for wildlife visiting a particular airport for the first time, such as migration season arrivals. These newcomers may not react the same way as the wildlife that permanently resides in the airport environment.

The outcome of the risk assessment matrix will make it possible for a wildlife control unit to prioritise the most hazardous species in the implementation of the WHMP. Prioritisation by a wildlife control unit will also signal to the airport administration that the unit appreciates the importance of cost-effective measures in a world of scarce financial and human resources.

The Figure 1 provides an example of how to allocate probability and severity in a risk matrix. The species placed in the red box are most hazardous to this particular airport, and the ones in green are the least hazardous.

Presenting the risk assessment in this manner also has the advantage of aligning with the management methodology of Safety Management Systems (SMS) framework adopted by ICAO.

**Table 3:** Example of a risk assessment matrix (3 X 4) used for wildlife management at airports

| | | **Severity** (damage risk ~ total body mass in kilograms per strike) | | | |
|---|---|---|---|---|---|
| | | Very high | High | Medium | Low |
| **Probability** (likelihood of a strike ~ the number of strikes) | High | | Black Vulture | Southern Lapwing | Barn Swallow |
| | Medium | | | Cattle Egret | |
| | Low | Greater Rhea | Horned Screamer | | House Sparrow |

### *Minimising the Likelihood*

At many airports, wildlife strike prevention is only taken to a professional level after a wildlife strike with substantial damage or even fatalities – so called Tombstone Management (reactive management). Significant strikes that act as a 'wake-up call' may lead to the considerations presented in the Table 4 by airport management personnel.

*Vegetation Management*

Besides the organic food found in waste, all other food is connected in the aerodrome-food-chain, starting with vegetation. Because food is one of the most important attractants, vegetation management is a crucial aspect of wildlife strike prevention.

The removal of all airside vegetation would eliminate all food that lives in the vegetation, but small soil invertebrates (earthworms, insect larvae, etc) would still be present and thus hazardous wildlife feeding on them would still be attracted. Because plants and grasses can re-grow quickly, depending on the soil and rainfall of a particular aerodrome, removing the vegetation is not a sustainable solution. Furthermore, vegetation prevents surface erosion and keeps debris (FOD) away from the runway.

**Table 4:** Doubts and considerations about wildlife strike management at airports

| Question | Consideration |
|---|---|
| Kill hazardous wildlife? | A dead animal will not represent a risk to aviation unless it becomes a source of food. While the airport habitat is still attractive with food, water or shelter, opportunistic newcomers will soon show up. They may be even more dangerous, since they are not familiar with the airport environments or they may be heavier and flock more than their antecedents |
| Scare wildlife away? | Many devices to scare wildlife away are available for purchasing and often the seller promotes them as the best solution for all situations. Unfortunately, the 'silver bullet' does not exist. When not properly applied, wildlife habituates quickly to any scaring device |
| Who has to do it? | ICAO stresses that it is necessary for wildlife control personnel to be competent and trained (see Doc 9137, Section 4.2.1.a.) as part of the airport safety management system |
| How to eliminate their access to food, water and shelter? | To successfully discourage wildlife from visiting the aerodrome, it is necessary to eliminate, or inhibit access to their attractants (i.e. food, water, shelter). Attractant management coupled with active harassment of stubborn individuals has proven the most successful approach |

The height and density of vegetation affects the visibility and accessibility of food. Tall, dense vegetation can inhibit access, inhibit prey detection, and reduce predator detection. Which height and density to aim for depends on the size and manoeuvrability of the hazardous wildlife as well as the vegetation and soil types present on the airfield. Trees and larger shrubs should be removed since they may hamper aircraft that skids off the runway. Furthermore, it is necessary to assess at which extent tall vegetation obstructs the Instrumental Landing System (ILS), exceeds Obstacle Limitation Surfaces (OLS) vertical markings and lights. The ILS and approach lights are usually close to the runway so animals in these areas pose a direct hazard to aviation.

Vegetation also provides shelter for wildlife. Species that like to hide in the vegetation may become invisible to their enemies. Such species avoid areas with short vegetation or bare soil. Therefore, these 'agoraphobic' species are not likely to enter the runway where predators may see them easily (quails for instance). While, other wildlife species prefer short vegetation or bare soiled areas. These 'claustrophobic' species avoid dense, tall vegetation, relying on their ability to see approaching predators well in advance to enable them rely on their camouflage plumage and remain motionless, or to flee, or even to counter attack them (lapwings for instance).Generally, species that prefer flat open areas such as short grass, bare soils or sealed areas like runways and taxiways, can present the greatest strike risk.

### *Wildlife Control Unit*

Vegetation management does not manage all species on airports. Therefore, Wildlife Strike Prevention Units are necessary to actively harass and disperse wildlife. These teams, composed of dedicated and trained personnel, are organised in a Wildlife Strike Prevention Unit integrated to an aerodromes SMS. Depending on allocated resources from airport management, the number of personnel may increase with, for example, foot patrollers. However, if not joined with the patrol vehicle, foot patrollers are too static to scare away the dynamic wildlife effectively enough. Wildlife Strike Prevention Units must be present at airside during airport operational periods, and over a long period of time to maintain effectiveness.

Quite often, wildlife control is not a single responsibility, but an extra task for other personnel such as fire fighters, airport safety officers or air traffic controllers (monitoring). ICAO audits identified low wildlife hazard awareness as a significant weakness in some parts of the world. This was due to a lack of regulation and formal training of assigned staff, as well as a general apathetic attitude amongst the aviation authorities, aerodrome operators and its general staff and the surrounding communities.

### *The Way Forward*

People are inclined to accept hazardous wildlife at aerodromes as *normal* or as an *act of God*.

Comments like…

"*Well, we've always had hazardous wildlife at our airports, we still have and we will always have*".

*"What can we do if waste management is under the responsibility of the Municipalities?"*

*"Wildlife strikes happen because birds do not get off our path"; and*

*"This is simply a risk that we have to accept"*.

… are quite common!

Nevertheless, all of these statements are biased and unilateral since birds have been flying around long before Leonardo Da Vinci started drawing his flapping ornithopter and a machine with a helical rotor.

Of course, a goal of "*zero*" wildlife strikes is not realistic. It is better to manage hazards to be *As Low As Reasonably Practicable* (ALARP) through a formal assessment guided by solid criteria.

Aviation personnel receive technical training to develop their tasks, and as such, they often believe solutions for the wildlife problems are solely technical ones. Although many technical scaring devices claim to be the '*silver bullet*', a more integrated approach is necessary, and some operators are now incorporating avian radars for the detection of wildlife at the airport and in its vicinity.

However, since the origin of the problem is not a technical one, the solution isn't either – it is a biological problem, requiring the coordination of biological experts to achieve biologically balanced and perennial solutions.

### *The Way Forward in Brazil*

During the last State Oversight (USOAP), Brazil achieved a high level of conformance to ICAO regulations. Although, only an average of 60% of struck species are identified at Family or Species level and there is no formally

established process in use to do that by DNA. There currently is no aeronautical regulation in place to guide airports and their stakeholders on how to cooperatively manage the wildlife strike risk, and until now, very few of Brazil's busiest aerodromes have a dedicated Wildlife Strike Prevention Unit to manage the wildlife problem. However, looking forward, a piece of the Federal Act (12.725 from October 16th, 2012) has been drafted, but not yet approved, to detail who, when, and how wildlife hazard management should be done in Brazil, with particular emphasis on the integration of off-aerodrome land use management to reduce the on-aerodrome strike risk. It is envisaged that this regulation will be released sometime in 2014, along with an environmental regulation that is currently under approval evaluation and that will allow aerodrome operators to manage hazardous species classified as very high, high, and moderate risk, in order to expedite the reduction of risk inside aerodromes.

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